



LETTERS

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The Last Inventor of the Telephone

SETH SHULMAN'S BOOK "THE TELEPHONE GAMBIT" AND ITS FINE REVIEW BY D. L. MORTON Jr. (29 February, p. 1188) focus on the 1876 dispute between Alexander Graham Bell and Elisha Gray over who invented the telephone. In fact, neither of them was first. Interestingly, different views on this topic prevail in different nations. French accounts tend to emphasize Charles Bourseul's theoretical underpinnings of the phone (1854). Many Italians, meanwhile, consider Antonio Meucci to be the real inventor—his phone apparently was operational in 1857 (acknowledged by a 2002 bill of the U.S. House of Representatives). Germans frequently cite the 1860 electric telephone by Phillippp Reis. Compared to all these pioneers, Gray and Bell came rather late. Bell is championed in his home country, Scotland; his adopted home, Canada; and the United States (he became a U.S. citizen 6 years after filing his patent). Unlike his predecessors, however, Bell was able to create a successful phone company, and he thus acquired financial and public relations resources that helped to widely promote his own view of who invented the phone.

What can we learn from this? When the time is ripe for an invention, it tends to be pursued and developed in various places until someone manages to make a public breakthrough. At least in popular culture, much of the credit is bestowed upon the last contributor, even when the essential original insights came from others. As they say: Columbus did not become famous because he was the first to discover America, but because he was the last.

JÜRGEN SCHMIDHUBER

Istituto Dalle Molle di Studi sull'Intelligenza Artificiale, 6928 Manno-Lugano, Switzerland, and TU München, Fakultät für Informatik, Garching bei München, Germany.

Thinking Outside the Reef

A RECENT REVIEW BY O. HOEGH-GULDBERG *et al.* ("Coral reefs under rapid climate change and ocean acidification," 14 December 2007, p. 1737) warns that ocean acidification will compromise carbonate accretion, with accelerating functional collapse of coral reef ecosystems worldwide if atmospheric CO₂ rises above 500 parts per million. However, readers were not offered a way to prevent the demise of coral reefs.

It is imperative that resource managers and

researchers promote ecologically sustainable development (ESD) on a global scale. We call on them to lead by example by investing in energy-efficient practices and sustainable forestry. The most practical means toward the goal of carbon neutrality involve buildings and forests, which are worth 22 and 14%, respectively, of necessary global CO₂ control (1).

Energy use in buildings offers the largest share of cost-effective opportunities for CO₂ mitigation, with ESD strategies such as daylighting, improved ventilation, cool roofs, shading, and insulation (1). Sustainable forestry

in coastal zones gives an added benefit to coral reefs by buffering the seaward run-off of nutrients and sediments (2). To overcome business-as-usual "paradigm blindness," resource managers, research institutions, and tourist operators who are dedicated to ecosystems at risk should use benchmarking to expose new methods, ideas, and tools (3, 4). We recommend systematic auditing and target-setting of CO₂ emissions and sinks. To save coral reefs, stakeholders must make management of CO₂ part of their core business, with the understanding that control is impossible without monitoring. Institutions need to disseminate ESD principles to the wider community—for example, by adding insulation to existing buildings and planting trees in riparian zones—to augment direct coral reef management actions such as promotion of herbivorous parrotfish.

ERIC L. PETERSON,¹ MARIA BEGER,²
ZOE T. RICHARDS³

¹Department of Architectural, Civil, and Mechanical Engineering, Victoria University, Melbourne MC, Victoria 3032, Australia. ²The Ecology Centre and The Commonwealth Research Facility for Applied Environmental Decision Analysis, University of Queensland, St. Lucia, QLD 4072, Australia. ³Australian Research Council Centre of Excellence for Coral Reef Studies, and School of Marine and Tropical Biology, James Cook University, Townsville, QLD 4811, Australia.

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Putting Ant-Acacia Mutualisms to the Fire

VARIOUS COMPLEX TRADE-OFFS DETERMINE the vitality and survival of acacias in dynamic savannas. Recently, T. M. Palmer *et al.* ("Breakdown of an ant-plant mutualism follows the loss of large herbivores from an African savanna," Reports, 11 January, p. 192) illustrated how exclusion of large herbivores changed ant-plant mutualistic



relationships on *Acacia drepanolobium* at a site in upland Kenya, emphasizing the dominant role of mammalian browsing in this system. However, when browsing on acacias decreases, so typically does trampling and grazing around the trees, increasing the risk of fires. These factors were not considered in their interpretation.

At Mkwaja Ranch on the Tanzanian coast, homogeneous woodlands of tall, pole-like *Acacia zanzibarica* trees—a myrmecophyte equivalent of *A. drepanolobium*—had established between 1954 and 2000 under intensive cattle grazing and in the virtual absence of browsing by wildlife (1–3). In 2002, the ant *Crematogaster sjostedti* occupied 99% of the trees with ant colonies (2, 4). After ranching had ceased in 2000, a continuous grass layer was established, and hot fires defoliated some woodlands up to about 10 m above ground in early 2003, resulting in 23% mortality of mostly smaller trees (2). Tunneling by wood-boring beetles—common in dead wood—may have increased mortality of smaller, already weakened trees, but tunneling was also found in apparently healthy trees, allowing ants to retire during fires (2).

Three weeks after fires, an unseasonal

foliage flush was observed whereby damaged trees produced more foliage than unaffected trees (2). Such costly investment by trees may serve to reboot resident *C. sjostedti* populations, surviving within the tunnels, via new nectar-secreting glands on leaf petioles. A complete loss of ant symbionts—invariably leading to high levels of insect herbivory on nutritious foliage (5–7)—may, however, have fatal consequences for myrmecophyte acacias (8). Fire and ant-plant-insect interaction deserve more scientific attention as potentially important evolutionary agents driving ant-acacia mutualisms in Africa.

ROLAND COCHARD^{1*} AND DONAT AGOSTI^{2,3}

¹Institute of Integrative Biology, Swiss Federal Institute of Technology, 8092 Zurich, Switzerland. ²Division of Invertebrate Zoology, American Museum of Natural History, New York, NY 10024, USA. ³Naturhistorisches Museum der Burgergemeinde Bern, 3005 Bern, Switzerland.

*To whom correspondence should be addressed. E-mail: roland.cochard@env.ethz.ch

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Response

COCHARD AND AGOSTI ARE CORRECT THAT interactions between herbivory and fire may influence the dynamics of ant-plant symbioses in African savannas. Their observations in a lowland site in Tanzania indicate that these influences are likely to be complex and site-dependent. In their study system, loss of grazers produced increased ground vegetation cover, increased fire intensity, and possibly increased dominance of the cavity-dwelling plant ant *Crematogaster sjostedti*. The precise pathway of causation suggested by this scenario differs from that operating in upland Kenya, but their observations do not alter our study's conclusion that browsing mammals can maintain ant-plant mutualisms in ecological time.

Our results cannot be explained by the effects of herbivore exclusion on fire regime. Fire is actively suppressed throughout much of the commercial rangeland that encom-

passes our study sites (i.e., natural and accidental fires are extinguished by fire crews, and the spread of fires is contained by the placement of fire breaks throughout the landscape) (1). Several experimental burns have suggested that more frequent fires would not favor *C. sjostedti* over other species in the acacia-ant guild. Similar to the scenario described by Cochard and Agosti, our fire experiments reveal disproportionate postfire survival of *C. sjostedti* colonies sheltered within large trees. However, *C. mimosae* and *C. nigriceps* also display high colony survivorship due to effective evacuation behaviors: Colonies of both species evacuate all workers, brood, and winged

reproductives to insulated cracks in the soil within approximately 45 minutes of smoke's reaching the tree. The fourth ant species in our system, *Tetraponera penzigi*, which inhabits mostly small trees, suffers nearly 100% colony mortality during a fire but is a stronger colonist of unoccupied trees than *Crematogaster* (2) and may therefore reassert itself in fire-thinned landscapes. Although herbivory and fire regimes frequently interact in African savannas, the processes observed by Cochard and Agosti would likely reinforce the dynamics we documented in the absence of fire.

Cochard and Agosti's assertion that decreases in browsing intensity are typically correlated with decreases in grazing intensity may not hold true in all cases. In our study system, the density of ground vegetation in the vicinity of adult *A. drepanolobium* is driven largely by cattle, and the removal of native browsers may or may not be associated with increased herbaceous cover. Our experimental design reflected this situation (both treatments contained plots with and without cattle, which therefore differed in understory cover). Thus, whatever additional complexity fire might add to the equation, our findings do not hinge on a

correlation between grazing and browsing intensity. We also note that postfire regrowth, bringing "new nectar-secreting glands on leaf petioles," would be unlikely to bolster *C. sjostedti* populations in our study system, where *C. sjostedti* does not intensively use nectaries (3).

Despite the differences in environmental context between upland Kenya and lowland Tanzania, the series of events outlined by Cochard and Agosti produce a net outcome qualitatively similar to that described in our study. In both cases, the exclusion of large mammals (browsers in our study, grazers in theirs) favors community dominance of the cavity-nesting ant *C. sjostedti*, although this occurs via different mechanistic pathways.

TODD M. PALMER,¹ MAUREEN L. STANTON,²
TRUMAN P. YOUNG,² JACOB R. GOHEEN,³
ROBERT M. PRINGLE,⁴ RICHARD KARBAN²

¹University of Florida, Gainesville, FL 32611, USA.

²University of California, Davis, CA 95616, USA. ³University of British Columbia, Vancouver, BC V6T 1Z4, Canada.

⁴Stanford University, Stanford, CA 94305, USA.

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Letters to the Editor

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